Arsenic and Well Water

By Dave Herrick

Is arsenic in well water a problem? It is in some parts of the world. And it could be in parts of this country, too, if new findings give the U.S. EPA reason to change its current arsenic drinking water standard.

Arsenic is an element. You might recall seeing arsenic's chemical symbol (As) in the *Periodic Table of the Elements* in your high school or college chemistry textbook. It is naturally occurring and found in the earth's crust all around the world. Although occasionally found in its elemental form, it is usually combined chemically with other metals, such as silver, copper, nickel, antimony, iron, and tin, or with oxygen or sulfur. In its pure state, arsenic is a gray-colored, brittle, crystalline solid. It maintains a centuries-old and well deserved reputation as a potent poison, due to its high toxicity Arsenic is also a carcinogen and is known to cause skin and lung cancer. It is suspected of causing other serious forms of cancer. Interestingly, though, arsenic is also an essential trace nutrient needed by many animals, and may even have a similar, but smaller, role in humans.

There are few uses for elemental, or pure, arsenic. Many substances contain arsenic, however. Some are natural, others are synthesized by man. Besides the arsenic naturally found in minerals and soil, arsenic has been used in insecticides, weed killers, rodenticides, and wood preservatives. It is a common ingredient in some industrial chemical wastes. It is also a component of fossil fuels, including oil, gasoline, coal, and wood. When these fuels are burned, arsenic is released into the air. Many smokers, often to their dismay, are surprised to learn the cigarette smoke they inhale contains arsenic. It's been used as a paint ingredient and even in some medications, but these uses have been discontinued.

Arsenic finds its way into surface and ground water, and ultimately into drinking water, in a number of ways. The main routes are through pesticide application, improper disposal of arsenic-containing waste chemicals, and dissolution from mineral deposits and rock formations. The bottom line is, arsenic is found most everywhere. We ingest it and we inhale it. Luckily, our bodies (primarily the liver) are able to detoxify low levels of arsenic intake (below 250 µg/day), ultimately excreting it in the urine stream via the kidneys. However, while this ability seems to protect us from arsenic's toxic effects, there is new evidence it may not protect us from its cancer causing properties.

Few U.S. groundwater supplies exceed the current U.S. EPA drinking water arsenic maximum contaminant level (MCL) of 50 micrograms/liter (µg/L). Most ground water contains lesser, or only trace, amounts. However, wells in some pails of the Southwest and several other more localized areas around the country have shown levels approaching or, in some instances, exceeding the 50 µg/L standard. A recent investigation in 10 southeastern Michigan counties, in fact, showed 272 (4 percent) of 6800 well water samples exceeded the standard. Testing done in 1994 of 1943 wells in two Wisconsin counties found 68 (3-5 percent) of the wells exceeded the arsenic standard. In both these investigations, evidence links the high arsenic levels to geologic sources.

The U.S. EPA arsenic MCL of 50 µg/L was originally established as a drinking water standard in 1942 by the U.S. Public Health Service (USPHS). Much of the research upon which the USPHS based the standard was conducted decades earlier. Recent information, however, has raised new questions about arsenic, and whether the 50 μg/L MCL provides adequate protection. As a result, U.S. EPA has been directed to further evaluate available health effects information with an eye toward lowering the MCL. This lower level is expected to be in the 2 to 20 μg/L range. By law, U.S. EPA must propose a new arsenic drinking water MCL by January 1, 2000, and a final regulation must be in on the books by January 1, 2001.

Reducing the arsenic MCL to a level between 2 and 20 μg/L from the current 50 μg/L will result in many new drinking water MCL exceedances by public water systems not now in violation. These water systems run the gamut from the large community system to the smallest transient noncommunity system. To reduce drinking water arsenic levels to meet a new, lowered standard, water systems will need to install new wells and/or water treatment systems. These steps require significant expenditures. U.S. EPA must carefully consider whether the health benefits gained are worth the expense required to reduce arsenic levels to meet a lowered MCL. Is the evidence linking an increased health risk with these low levels of arsenic valid and based on good science? U.S. EPA must assess all the available information to determine the best course of action, considering risks, benefits, and costs. It will be a tough balance to find. Add to this the fact that water from tens of thousands of private wells around the country would also now have arsenic concentrations exceeding the drinking water standard applied to public systems. How will private well owners react to that situation?

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What new health effects information prompted U.S. EPA to take a closer look at arsenic? Some of it came about as a result of epiderniological studies done after higher than expected cases of urinary bladder and kidney cancer were observed, beginning in the 1970s, along the southwest coast of Taiwan. Studies suggest an association between the increased cancer risk and the high well water arsenic concentrations that occur there.

Even more recent, but equally disturbing, are reports of arsenic poisoning from well water supplies in portions of Bangladesh and its neighboring Indian states of West Bengal, Tripura, Assam, Mizoram, and Meghalaya. Reports of arsenic poisoning in the region first occurred in 1983 in West Bengal, and have been spreading ever since. One report estimated the affected area in West Bengal alone encompasses an area of 38,000 square kilometers (14,600 square miles). That area is home to 38 million people of whom, according to a 1996 report, an estimated 1.1 million are drinking well water containing arsenic above the 50 μg/L level. The same report stated more than 200,000 people had experienced skin lesions or other symptoms characteristic of arsenic poisoning. Several arsenic poisoning related deaths have also occurred there. In 1993, reports of similar problems in nearby Bangladesh began. The situation there has quickly mushroomed into a public health problem of great proportion.

Investigation in both India and Bangladesh has pointed to well water as the most likely source of the arsenic poisoning. In the 1960s and 1970s, thousands of wells were drilled in these regions, mainly for irrigation to increase rice production. The wells were also used to provide a more reliable and bacteriologically safe water supply than the untreated surface water commonly used at the time. Elevated arsenic concentrations have been found in the water produced from many of the wells. The arsenic in the ground water appears to be of geological origin. Some scientists speculate that increased pumping lowered ground water levels, causing chemical changes that resulted in arsenic being leached out of the rock and soil and into the ground water. This has not been confirmed, and other researchers have found conflicting evidence. What is known for sure is that arsenic in well water in concentrations above the World Health Organization's arsenic guideline of 10 µg/L (compared to U.S. EPA's current MCL of 50 µg/L) occur widely here, with levels as high as 9000 µg/L. Hundreds of thousands of people are suffering from some degree of arsenic poisoning, and at least 60 deaths have occurred.

Research on arsenic and studies of arsenic in drinking water are being conducted in several parts of the world, including the United States. As part of their rulemaking, U.S. EPA will pay close attention to the research results and what they indicate are the health effect concerns associated with low levels (arsenic levels less than 50 µg/L) of arsenic. In addition, other groups and organizations are looking at how to best deal with the health problems caused by arsenic in places like Bangladesh and India.

Treatment technologies are available to reduce arsenic concentrations in drinking water. Reverse osmosis units, distillers, activated alumina filters, and anion exchange filters can all be used to reduce arsenic in drinking water. Pretreatment may be needed in some cases to ensure acceptable treatment by the primary unit. Some of the treatment technologies may not be amenable to point-of entry, whole house treatment. In these cases, point-of-use units may be the best option. In any case, a thorough water analysis is recommended before a final treatment technique is proposed. Periodic process control sampling should be done after a treatment system has been placed in operation to ensure treatment objectives are being met.

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Arsenic in drinking water has been a concern for decades. Along with new and better laboratory tests, and an expanding water quality knowledge base and its relationship with mineral geology, have come new public health concerns. U.S. EPA is under the gun to develop a lower, more stringent, arsenic drinking water MCL. A reduction from the current MCL of 50 µg/L to a lower level will lead to an increase in the number of public water system drinking water violations for arsenic. It will also give rise to new concerns from owners of private water wells with arsenic concentrations above the new standard. Both may result in a demand for treatment technologies or new wells to reduce the suspected health risks associated with low levels of arsenic exposure. WWJ

Dave Herrick, Herrick Outdoor Photography, is a freelance photographer and writer from northwest Wisconsin. He has a special interest in the water well industry, and is a Water Well Journal *contributing editor*